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EFFECT OF HIGH QUALITY ADDITIONAL TRAINING ON REHABILITATION OUTCOME OF PATIENTS WITH KNEE ENDOPROSTHESIS

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SUMMARY

In order to evaluate the effect of a simple low-cost technical assistance training system, patients with knee prosthesis performed daily additional high quality exercises in addition to their usual rehabilitation program (reha@on). In that context, a prospective, parallel-group, randomized clinical trial was performed comparing high quality open-chain exercises to standard cycling. All patients received pre- and post-rehabilitative clinical gait analysis. The functional outcome of the additional rehabilitation training has been assessed with two quantitative parameters, namely the area and time outside of 95% confidence interval of a norm collective (OrthoMIT norm). The gait pattern of both patient groups showed even after rehabilitation significant differences compared to the healthy norm group. However compared to the cycling training the functional outcome was significantly improved when the low cost technical assistance training system (TATS) was used.

INTRODUCTION

Due to the growing number of people with degenerative hip or knee joint diseases, individualized rehabilitation physiotherapy and adequate postoperative training becomes increasingly relevant. However, additional costs for the health system should be avoided. A simple technical assistance system has been implemented, which allows the patient to independently perform an additional physiotherapeutic exercise program. Thereby the patient is guided and controlled through the exercise by the help of a visual feedback. In that way, the amount of individual exercises on a high quality level can be increased while the rehabilitation costs remain constant.

The aim of this study is to demonstrate the functional gain of additional independent training for patients with knee endoprosthesis through the technical assistance system.

METHODS

40 Patients with knee endoprosthesis were attended during their 4-weeks rehabilitation. During their time of rehabilitation 20 patients received an additional training program with a self-operating training system, which

intensifies and to a possible extent controls the rehabilitation effort by the help of a visual feedback. The 20 patients in the control group trained in addition to the standard-type rehabilitation every day 30 minutes with a bicycle ergometer.

The training system is based on resistive elements like elastic tubes and bands, which are commonly used in physiotherapy. A force sensor, connected to the resistive materials, offers real-time information on the performed motion, namely the range of motion and the performed velocity. In contrast to simple cycling the TATS allowed open-chain training adapted to the individual need of the patient. In the beginning of the rehabilitation, exercises with the resistive materials are trained and recorded with the guidance of a physiotherapist. The system then provided a real-time feedback, which visualized the targeted and the performed movement and thus was motivating and guiding the patients to move in the intended manner (Figure 1).

To evaluate the functional performance of the lower

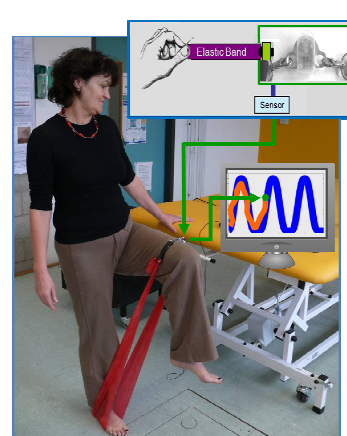


Figure 1: Open-chain training with TATS.

extremity joint chain, the kinematics and surface-EMG (sEMG) were recorded. During gait analysis patients walked in their individual gait rhythm and velocity. The data of the patients gait were captured by an optoelectronic ten-camera system (VICON MX+T20). Joint angles were calculated by Plug-In Gait from VICON,

synchronized to the gait cycle and averaged over 15 steps. In addition to

kinematics, sEMG were derived from 8 leg muscles to detect the muscular coordination pattern. SEMG electrodes were placed on the muscles according to SENIAM recommendations. Detected joint angles were compared to a

norm of healthy gait cycles from 25 volunteers of same age and sex (OrthoMIT norm). The gait has been considered as pathologic when the joint angles exceed the 95% confidence interval of the OrthoMIT norm. The individual gait pattern, have been assessed by calculating two quantitative parameters. The first is the area outside the 95% confidence interval of the norm and the second is the percentage of the gait cycle outside the norm (Figure 2).

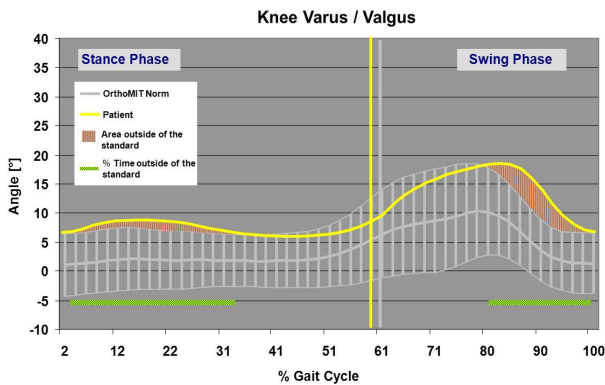


Figure 2: Quantitative evaluation of pathology.

For the statistical analysis p-values are based on one sample t-test.

RESULTS AND DISCUSSION

After 4 weeks rehabilitation the individual functional performance was improved significantly in both groups, although still significant functional deficits are determined compared to the healthy gait. (Figure 3a and 3b)

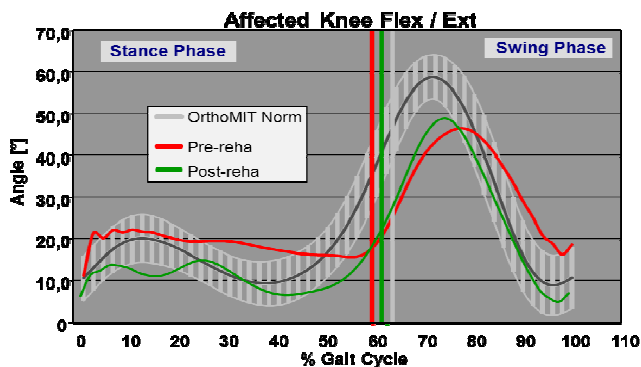


Figure 3a: Kinematics Pre- and Post-Rehabilitation of the bicycle-group.

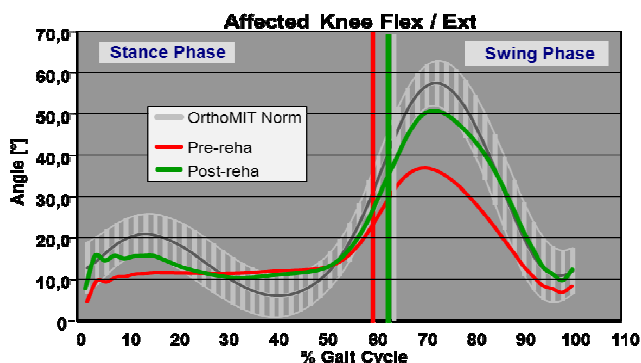


Figure 3b: Kinematics Pre- and Post-Rehabilitation of the TATS-group.

However both gait kinematics as well as muscular coordination was significantly improved when performing the high quality open-chain training with the TATS compared to simple cycling (Figure 4a and 4b).

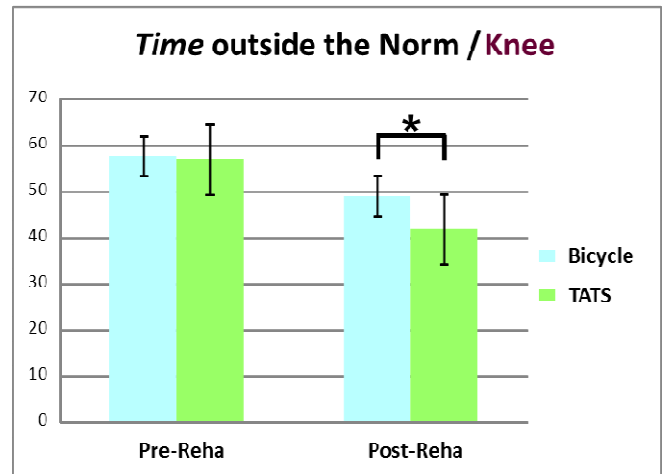


Figure 4a: Comparison bicycle and TATS- group regarding parameter time outside the standard.

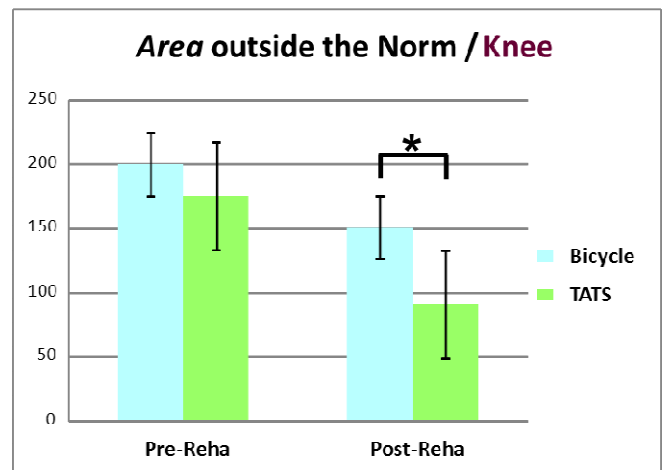


Figure 4b: Comparison bicycle and TATS-group regarding parameter area outside the standard.

CONCLUSION

Additional training with the technical assistance training system (TATS) significantly improves the rehabilitation outcome already after four weeks.

As long as the functional results have not been satisfactorily resolved, the self-operating additional training should be continued. Since additional stand-alone exercise becomes possible with the TATS, rehabilitation can be continued by the patient in their home environment.